ELECTROHYDRODYNAMIC FLOW APPLICATION IN GAS DISCHARGE LASER CIRCULATION SYSTEM

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Abstract: Electric discharge N_2-laser with circulation system based on electrohydrodynamic flow is described. Experimental studies and mathematical modeling of EHD flow considering configuration of circulation chamber and discharge gap have shown value of a stream more than 15 l/s.

Electrohydrodynamic (EHD) gas acceleration systems are extensively used in cooling and circulation devices, and in laser technique for active air flow control [1-3]. The advantage of these devices is the absence of moving parts, vibration and noise, as well as the need to use preionisation. They are simple, compact and reliable compared to conventional electromechanical fan. The most important factor affecting maximum frequency of electric discharge lasers impulse repetition is the velocity of working gas mixture circulation V in the interelectrode gap [4-7]. In its turn the circulation rate is determined by the value of gas flow W, provides by circulation system. Electric discharge N_2-laser with EHD circulation system integrated in gas circulation and cooling contour was investigated. Experimental studies and mathematical modeling of gasdynamic processes in EHD flow considering configuration of circulation chamber and the area of discharge gap of 200 cm^3 were carried out. Multicascade circulation system consists of plasma emitters (PE) and ion collectors. Researches with amount of PE in one stage from one to six were conducted. According to our results, the value of the gas flow increases in proportion to the amount of PE by increasing the area of emitter. Therefore, to obtain $W \geq 15$ l/s, required for efficient laser operation, it is necessary to use more than three PE. The system with two emitters in two cascade configuration and with one PE and four stages was optimum for velocity of gas flow and efficiency. Operating voltage of such systems was 17 kV and the flow velocity reached 3 m/s in the output of single stage and 1,3 m/s in laser discharge gap. At this speed, the volumetric flow rate is of 16 l/s, thereby we are able to obtain the N_2-laser output energy of to 3 mJ with a pulse repetition frequency of 50 Hz using a single stage and up to 150 Hz using four respectively.

REFERENCES

1. V.Y. Khomich et al. *SPEEDAM 2016.* **1** (2016) 918.
2. A.P. Kuryachii et al. *Aerospace Science and Technology*. **59** (2016) 155.
3. S.V. Nebogatkin et al. *Plasma Physics Reports* **42** (2016) 104.
4. I.E. Rebrov et al. *Hakone 14.* **1 (**2014) 78.
5. V.A. Yamshchikov et al. *ALT' 15.* **1** (2015) 175.
6. V.Y. Khomich et al. *JOP: CS.* **652** (2015) 012036.
7. V.A. Yamshchikov et al. *ALT'16.* **1** (2016) LSM-P-12.